SMART SECURITY SYSTEM

System Manual

COURSE: EE 481 / SPRING 2014

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GROUP: 01

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Project abstract:

The safety of our properties has become important to our everyday lives. The issue we face these days is that security systems that are currently in the market are expensive, not user friendly, and require technical knowledge. As a team, we came together to create an integrated system, which is efficient, cost effective and user friendly to every individual.

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1) Introduction

Nowadays, home security systems are important and crucial to our lives. The issue now days are that home security systems that exist in the market have monthly fee, some are non-user friendly to many individuals. As a team we came together to create an integrated system, which is efficient and cost effective and accessible to every individual that requires one.

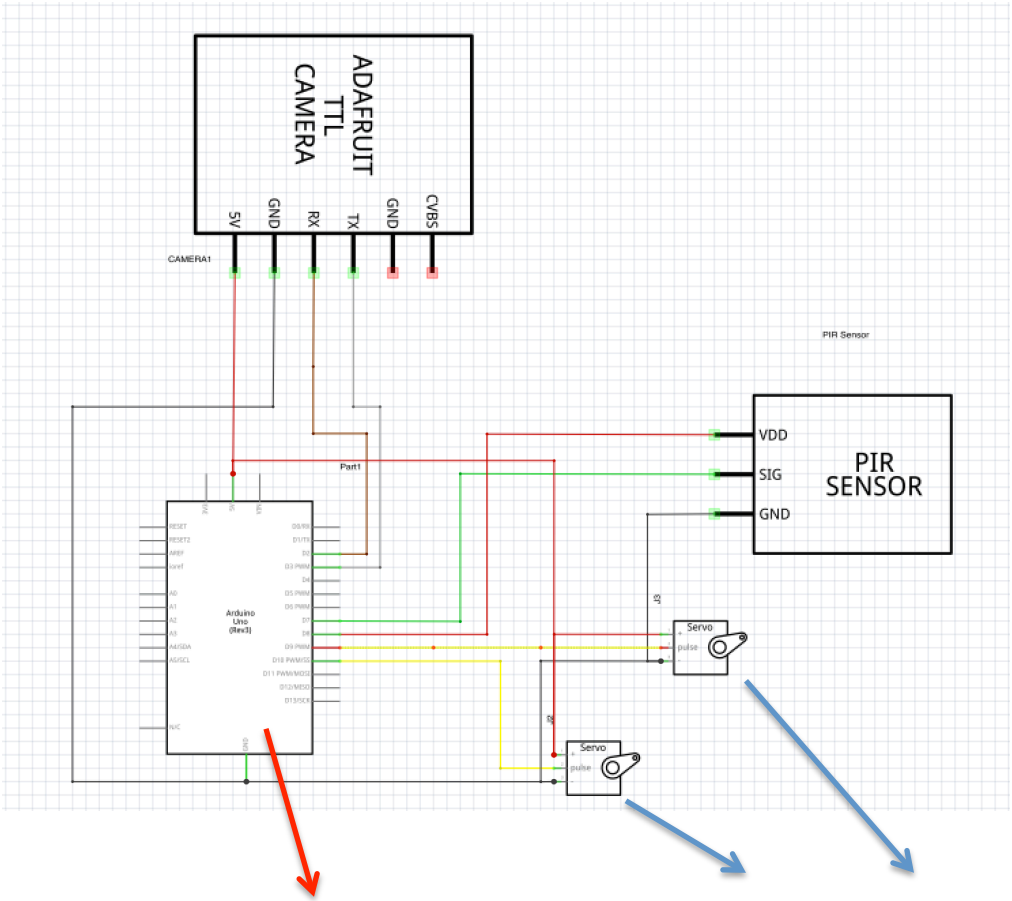
2) Design Achievements:

Our goal to achieve this integrated system was to divide our group into sub-groups and then inter-connect the pieces together. Since we are two individuals; one member started working on PIR sensor. The first step was to get a simple application Arduino sketch running for the motion sensor. After that the member moved on to the rotor assembling and then created a simple application Arduino sketch to run it. As for the second member he focused on creating the camera code and running that on Arduino sketch in addition he worked email notification code. Finally we came together to combine the sub-systems to gap the bridge required to fulfill our goal to successfully when a motion is detected it triggers the camera to turn to the position of motion with the help of pan/tilt rotor. In addition to the motion an alert email will trigger with the help of communication between the computer base system and i-phone. One of the outcomes we had to learn was local communication between devices and their limitations. One of the extra angles created in this project was implementing a OSC app that helps with the rotor turning which in turn gave the customer hands on control. The development of the coding parts of the system seemed challenging but the end product is a result of over achieving these challenges in any way possible.

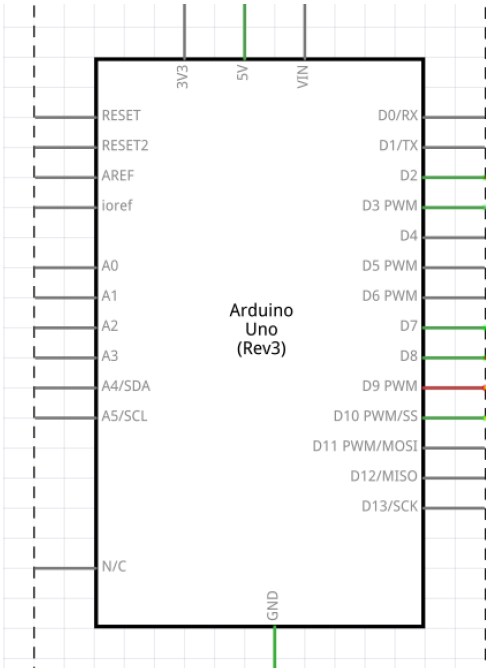
3) *Hardware design*

**All schematics have been created manually using Fritzing software.*

i) Schematics

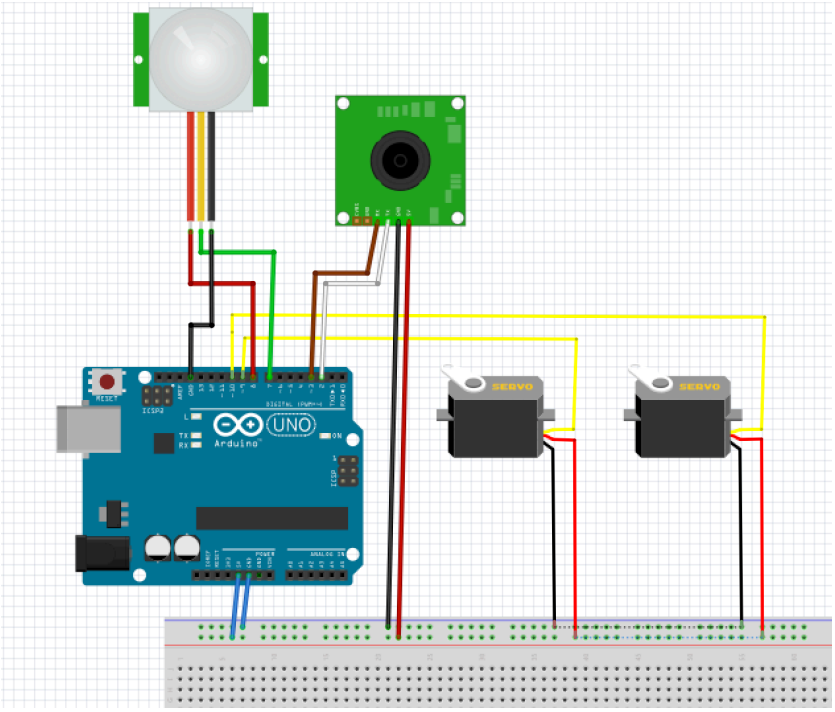


Servo Motors 1 & 2



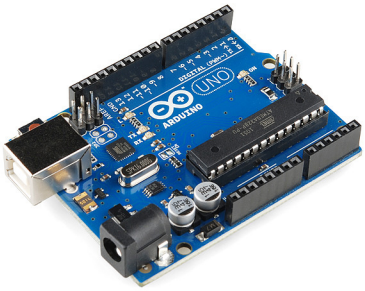
Arduino Uno Micro Controller Rev. 3

ii) Physical Layout



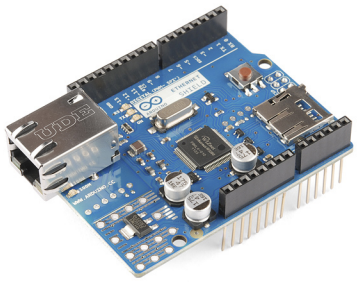
iii) List of Materials

- ***Arduino Uno Micro Controller: $29.95***

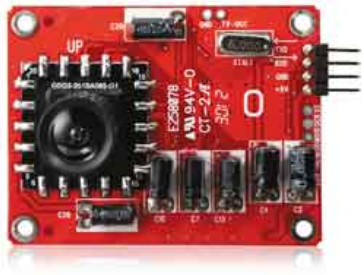


- ***Micro SD Card: $4.95***

- ***Ethernet Shield: $45.95***

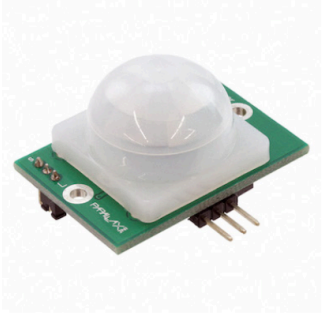


- ***Camera Shield: $44.99***

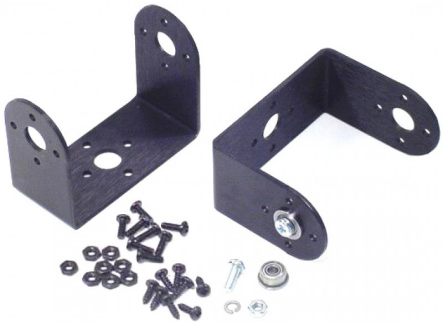


- ***Servo motors: $8.83***

- ***PIR Motion Sensor: $4.99***



- ***Servo Motor Brackets: $10.95***



iv) Specs:

- ***Arduino Uno***
  - • Microcontroller: ATmega328
  - • Operating Voltage: 5V
  - • Input Voltage (recommended): 7-12V
  - • Input Voltage (limits): 6-20V
  - • Digital I/O Pins: 14 (of which 6 provide PWM output)
  - • Analog Input Pins: 6
  - • DC Current per I/O Pin: 40 mA
  - • DC Current for 3.3V Pin: 50 mA
  - • Flash Memory: 32 KB (ATmega328) of which 0.5 KB used by bootloader
  - • SRAM: 2 KB (ATmega328)
  - • EEPROM: 1 KB (ATmega328)
  - • Clock Speed: 16 MHz

- ***Ethernet Shield***
  - • Micro SD card connector with active voltage translators
  - • Power over Ethernet ready
  - • On board reset controller
  - • Compatible with the Arduino MEGA board

- ***PIR motion Sensor***
  - • Detect a person up to - 30 ft. away, or up to 15 ft. away in reduced sensitivity mode
  - • Jumper selects normal operation or reduced sensitivity
  - • Source current up to 12 mA @ 3 V, 23 mA @ 5 V
  - • Mounting holes for 2-56 sized screws
  - • 3-pin SIP header ready for breadboard or through-hole projects

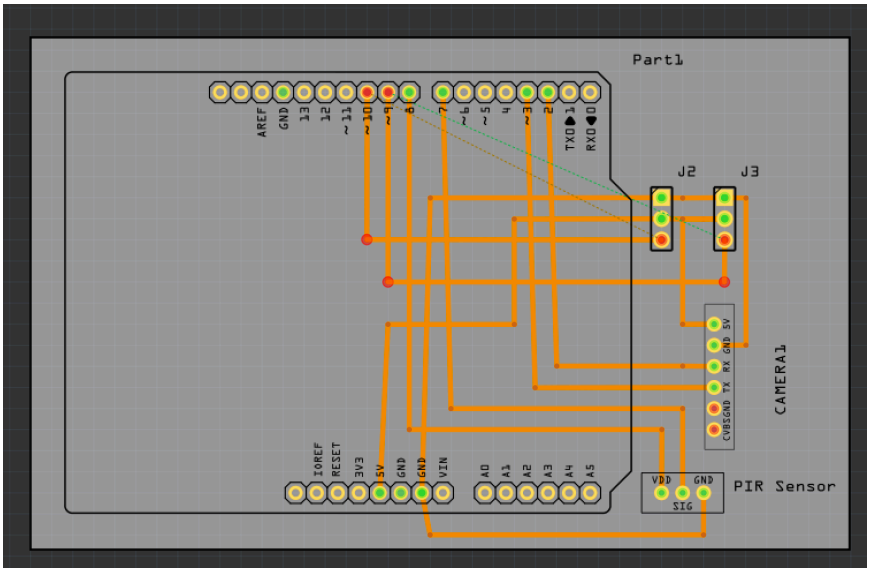
- ***Camera Shield***
  - A JPEG color camera board that can be made to work with an Arduino board
  - Integrated with an enhanced image processor to generate up to 640x480 resolution
  - Support both SPI/UART interface
  - Build a digital camera with the addition of a SD card shield for storage
  - Build a bar code reader with the addition of a touch shield
  - Build a wireless network camera with the addition of a Wi-Fi shield
  - One foot long flat cable (4 wires) is used to connect camera board PCB (J2) and the Arduino board
  - Supports composite video output
  - Minimum zoom in distance is 30cm

- ***Memory Card***

- Performance up to 30MB/s
- High-Speed Class Rating - Class 10: 10MB/sec. minimum data transfer rate
- Compliant with the SD Card Association card 3.00 specification
- Operating temperatures: -13°F to 185°F (-25°C to 85°C)

- ***Servo Motors***
  - Speed (sec/60o): 0.16
  - Torque (Kg-cm/Oz-in): 4.1/57
  - Size (mm): 41 x 20 x 37
  - Weight (g/oz): 45.5/1.6

v) PCB Layout



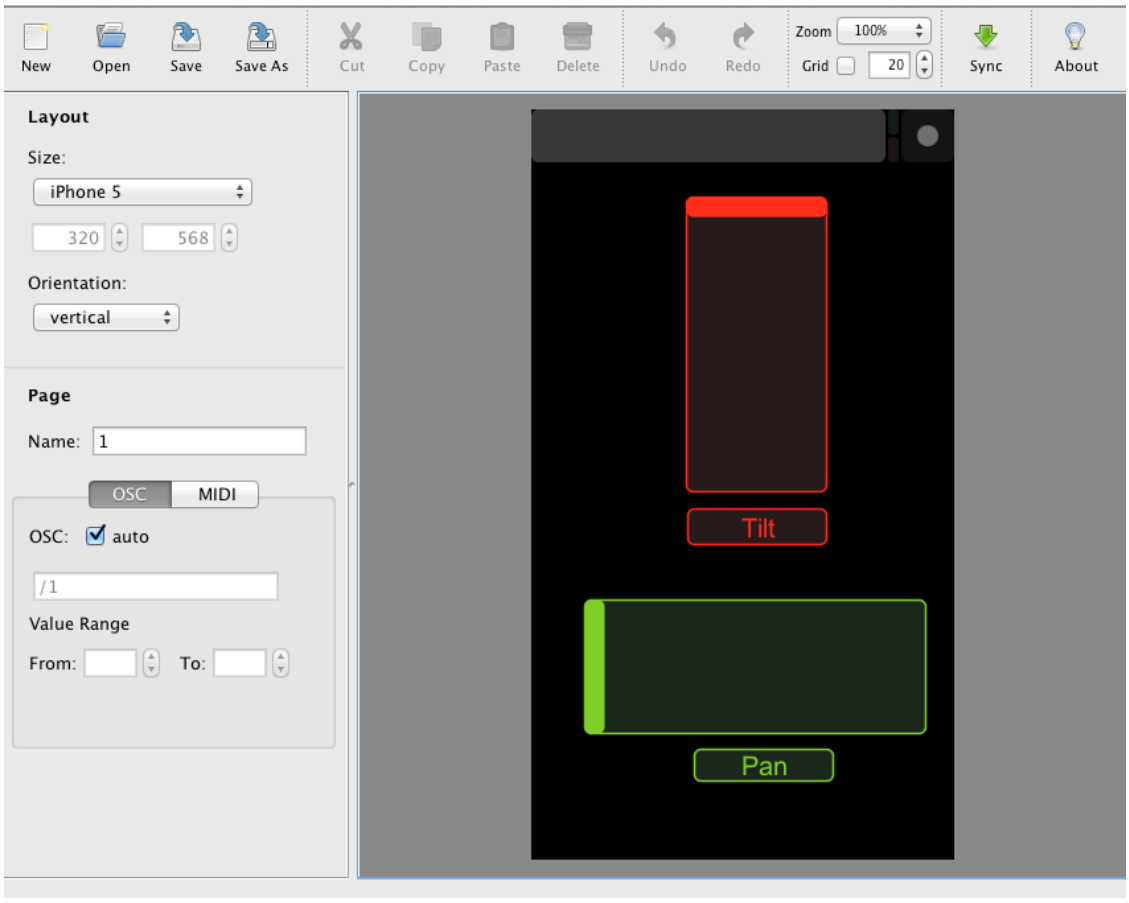
4) *Software design:*

Arduino IDE:
Used to write main sketches for Arduino Uno using C++ language.

Processing:
Programmed in C++ and used in combination with Arduino Uno. Because both combined provides an easy way for the software you write to talk to the outside world, and vice-versa. In our case, the outside world is the iOS app.

Python 2.7:
Python allows us to express concepts in fewer lines of code than would be possible in languages such as C. We used it to be executed from within Processing and its task was to submit email alert when motion was detected.

Touch OSC Software + iOS app:
Touch OSC is a great way to create templates for iOS device. We used it to create Servo motors commands (Tilt/Pan) and it works in conjunction with Processing as long as the user uses the same wifi network as the computer. It helped us send and retrace signals over wifi and control the servos in real time.



5) *Source Code listing:*

Python: email alert code for a gmail account as an example

```
import time
#~ import serial
import smtplib
TO = “Email goes here”
GMAIL_USER = “Email goes here”
GMAIL_PASS = “password goes here”
SUBJECT = “Alert!!”
TEXT = 'Your PIR sensor detected movement'
#~ ser = serial.Serial('/dev/tty.usbmodem1411', 9600)
#~ def send_email():
print("Sending Email")
smtpserver = smtplib.SMTP("smtp.gmail.com",587)
smtpserver.ehlo()
smtpserver.starttls()
smtpserver.ehlo
smtpserver.login(GMAIL_USER, GMAIL_PASS)
header = 'To:' + TO + '\n' + 'From: ' + GMAIL_USER
header = header + '\n' + 'Subject:' + SUBJECT + '\n'
print header
msg = header + '\n' + TEXT + ' \n\n'
smtpserver.sendmail(GMAIL_USER, TO, msg)
smtpserver.close()
#~ while True:
    #~ message = ser.readline()
    #~ print(message)
    #~ if message[0] == 'M' :
        #~ send_email()
    #~ time.sleep(0.1)
```

Processing:

```
import oscP5.*;
import netP5.*;
import processing.serial.*;
Serial myPort;
OscP5 oscP5;

int value1 = 0;
int value2 = 0;
NetAddress myRemoteLocation;

void setup(){

println(Serial.list());
myPort = new Serial(this, Serial.list()[2],9600);
oscP5 = new OscP5(this, 8000);
myRemoteLocation = new NetAddress("Your iOS IP goes here",9000);

}

void oscEvent(OscMessage theOscMessage){

String addr = theOscMessage.addrPattern();

if(addr.indexOf("/1/Servo1") != -1){
 value1 = int(theOscMessage.get(0).floatValue());
 myPort.write(value1 + "a");
 println("Servo1: " + value1);
 }

else if(addr.indexOf("/1/Servo2") != -1){
 value2 = int(theOscMessage.get(0).floatValue());
 myPort.write(value2 + "b");
 println("Servo2: " + value2);
 }

}
}
```

Arduino Sketch:

```
// Servo lib
#include <Servo.h>
// SD card stuff
#include <SD.h>
// SW Serial
#include <SoftwareSerial.h>

/*
  Software serial for Camera

 Receives from the hardware serial, sends to software serial.
 Receives from software serial, sends to hardware serial.

 The circuit:
 * RX is digital pin 10 (connect to TX of Camera)
 * TX is digital pin 11 (connect to RX of Camera)
            */
// define camSerial SW serial conn
SoftwareSerial camSerial(10, 11); // RX, TX

// Servo Object
Servo myServo1;
Servo myServo2;

// File Object
File myFile;

// ethernet shield = 4
const uint8_t SdChipSelect = 4;

char myFileName[16];
int myFileNr=1;

// Sensor vars
int pirPin = 7;
int minSecsBetweenEmails = 5; // 1 min
long lastSend = -minSecsBetweenEmails * 1000l;

void setup()
{
 // attach Servos
 Serial.begin(9600);
 myServo1.attach(9);
 myServo2.attach(10);

 // PIR pin
 pinMode(pirPin, INPUT);

 // pin 4 = ardunio ethernet shield
 SD.begin(SdChipSelect);

 // SW Serial for Camera
 camSerial.begin(115200);

 // set jpeg quality
 VC0706_compression_ratio(66);
 delay(100);
 capture_photo("test.jpg");

 // turn on power for PIR on pin 8
 pinMode(8, OUTPUT);
 digitalWrite(8, HIGH);

}

void loop()
{
```

```
  // Servo loop
  static int value = 0;
  if(Serial.available() > 0){
    char message = Serial.read();
    switch(message){
    case'0'...'9':
      value = value * 10 + message - '0';
      break;

    case'a':
      if(value > 0 && value <= 180){
        int value1 = map(value,0, 180, 550,2300);
        myServo1.write(value1);
        value = 0;
        break;
      }

    case'b':
      if(value > 0 && value <= 180){
        int value2 = map(value, 0, 180, 550, 2300);
        myServo2.write(value2);
        value = 0;
        break;
      }
    }
  }

  // create a new file each and every time
  while (myFileNr != 0) {
    sprintf(myFileName, "CCC%03d.jpg", myFileNr);
    if (SD.exists(myFileName) == false) break;
    myFileNr++;
  }

  // check PIR sensor
  long now = millis();
  if (digitalRead(pirPin) == HIGH){
                                // take picture
                                capture_photo(myFileName);
                                delay(10);
                                // send email
    if (now > (lastSend + minSecsBetweenEmails * 1000l)){
        Serial.println("M");
        lastSend = now;
    }
    else{
      Serial.println("Too soon");
    }
  }
  //delay(500);

}

void capture_photo(char myFileName[]) {

  // make sure video engine is running
  VC0706_frame_control(3);
  delay(10);

  // Check to see if the file exists:
  // if exists,delete the file:
  if(SD.exists(myFileName)) SD.remove(myFileName);


  // freeze video enginge
  VC0706_frame_control(0);
  delay(10);
  rx_ready=false;
  rx_counter=0;
```

```
  camSerial.end();                                // clear all rx buffer
  delay(5);

  camSerial.begin(115200);

  //get frame buffer length
  VC0706_get_framebuffer_length(0);
  delay(10);
  buffer_read();

  // store frame buffer length for coming reading
  frame_length=(VC0706_rx_buffer[5]<<8)+VC0706_rx_buffer[6];
  frame_length=frame_length<<16;
  frame_length=frame_length+(0x0ff00&(VC0706_rx_buffer[7]<<8))+VC0706_rx_buffer[8];

  vc_frame_address =READ_DATA_BLOCK_NO;

  myFile=SD.open(myFileName, FILE_WRITE);
  while(vc_frame_address<frame_length){
    VC0706_read_frame_buffer(vc_frame_address-READ_DATA_BLOCK_NO, READ_DATA_BLOCK_NO);
    delay(9);

    //get the data with length=READ_DATA_BLOCK_NObytes
    rx_ready=false;
    rx_counter=0;
    buffer_read();

    // write data to file
    myFile.write(VC0706_rx_buffer+5,READ_DATA_BLOCK_NO);

    //read next READ_DATA_BLOCK_NO bytes from frame buffer
    vc_frame_address=vc_frame_address+READ_DATA_BLOCK_NO;

  }

  // get the last data
  vc_frame_address=vc_frame_address-READ_DATA_BLOCK_NO;

  last_data_length=frame_length-vc_frame_address;


  VC0706_read_frame_buffer(vc_frame_address,last_data_length);
  delay(9);
  //get the data
  rx_ready=false;
  rx_counter=0;
  buffer_read();

  myFile.write(VC0706_rx_buffer+5,last_data_length);

  myFile.close();

  // restart video enginge
  VC0706_frame_control(3);
  delay(10);
}


void VC0706_read_frame_buffer(unsigned long buffer_address, unsigned long buffer_length)
{

//The following lines are directly from Arduino since they are the basis to make the camera function
  tx_vcbuffer[0]=VC0706_PROTOCOL_SIGN;
  tx_vcbuffer[1]=VC0706_SERIAL_NUMBER;
  tx_vcbuffer[2]=VC0706_COMMAND_READ_FBUF;
  tx_vcbuffer[3]=0x0c;
  tx_vcbuffer[4]=FBUF_CURRENT_FRAME;
  tx_vcbuffer[5]=0x0a;                            // 0x0a=data transfer by MCU mode; 0x0f=data transfer by SPI interface
  tx_vcbuffer[6]=buffer_address>>24;                                    //starting address
  tx_vcbuffer[7]=buffer_address>>16;
```

```
  tx_vcbuffer[8]=buffer_address>>8;
  tx_vcbuffer[9]=buffer_address&0x0ff;

  tx_vcbuffer[10]=buffer_length>>24;                    // data length
  tx_vcbuffer[11]=buffer_length>>16;
  tx_vcbuffer[12]=buffer_length>>8;
  tx_vcbuffer[13]=buffer_length&0x0ff;
  tx_vcbuffer[14]=0x00;                         // delay time
  tx_vcbuffer[15]=0x0a;


  tx_counter=16;

  buffer_send();
}


void VC0706_frame_control(byte frame_control)
{
  if(frame_control>3)frame_control=3;
  tx_vcbuffer[0]=VC0706_PROTOCOL_SIGN;
  tx_vcbuffer[1]=VC0706_SERIAL_NUMBER;
  tx_vcbuffer[2]=VC0706_COMMAND_FBUF_CTRL;
  tx_vcbuffer[3]=0x01;
  tx_vcbuffer[4]=frame_control;
  tx_counter=5;

  buffer_send();
}


void VC0706_get_framebuffer_length(byte fbuf_type)
{
  if(fbuf_type>1)fbuf_type=1;
  tx_vcbuffer[0]=VC0706_PROTOCOL_SIGN;
  tx_vcbuffer[1]=VC0706_SERIAL_NUMBER;
  tx_vcbuffer[2]=VC0706_COMMAND_GET_FBUF_LEN;
  tx_vcbuffer[3]=0x01;
  tx_vcbuffer[4]=fbuf_type;
  tx_counter=5;

  buffer_send();
}


void VC0706_uart_power_save(byte power_save_on)
{
  tx_vcbuffer[0]=VC0706_PROTOCOL_SIGN;
  tx_vcbuffer[1]=VC0706_SERIAL_NUMBER;
  tx_vcbuffer[2]=VC0706_COMMAND_POWER_SAVE_CTRL;
  tx_vcbuffer[3]=0x03;
  tx_vcbuffer[4]=00;                            //power save control mode
  tx_vcbuffer[5]=01;                            // control by UART
  tx_vcbuffer[6]=power_save_on;                         //start power save
  tx_counter=7;

  buffer_send();
}


void VC0706_compression_ratio(int ratio)
{
  if(ratio>63)ratio=63;
  if(ratio<13)ratio=13;
  int vc_comp_ratio=(ratio-13)*4+53;
  tx_vcbuffer[0]=VC0706_PROTOCOL_SIGN;
  tx_vcbuffer[1]=VC0706_SERIAL_NUMBER;
  tx_vcbuffer[2]=VC0706_COMMAND_WRITE_DATA;
  tx_vcbuffer[3]=0x05;
  tx_vcbuffer[4]=01;                    //chip register
```

```
  tx_vcbuffer[5]=0x01;                //data num ready to write
  tx_vcbuffer[6]=0x12;                //register address
  tx_vcbuffer[7]=0x04;
  tx_vcbuffer[8]=vc_comp_ratio; //data

  tx_counter=9;

  buffer_send();
}

void buffer_send()
{
  int i=0;

  for (i=0;i<tx_counter;i++)
    camSerial.write(tx_vcbuffer[i]);

  tx_ready=true;
}

void buffer_read()
{
  bool validity=true;

  if (rx_ready)                                    // if something unread in buffer, just quit
    return;

  rx_counter=0;
  VC0706_rx_buffer[0]=0;
  while (camSerial.available() > 0)
  {
    VC0706_rx_buffer[rx_counter++]= camSerial.read();
    //delay(1);
  }

  if (VC0706_rx_buffer[0]!=0x76)
    validity=false;
  if (VC0706_rx_buffer[1]!=VC0706_SERIAL_NUMBER)
    validity=false;

  if (validity) rx_ready=true;


}
```

6) Testing:

The below table illustrates the failing scenarios of our Smart Security System. This was used to check to overcome issues when system failed to work efficiently.

System Failure	Cause
• OSC app does not connect.	• App has the wrong local IP address must match with the base computer IP address • Hardware failure connection loose.
• PIR sensor doesn't trigger.	• Hardware failure connection loose.
• Servo rotor not responding	• Server is not retrieving data from sensors.
• Delay between phone application and system	• Network busy.

7) Safety Precautions:

Our system unlike other home security systems is a user friendly, environmental friendly no chemicals were used in the design process of the system. The system was constructed in a way to shrink user exposure to high temperature, electrical shocking from wiring, and any chemical leaking from devices. The system runs on a fixed power either generated by the computer base or external voltage power supply without user interaction required (5V to 10V). For future maintenance and development no external chemicals of any kind should be used. In the case of system failure such as fire or over heating of system a well defined enclosed PVC box will be distrusted with the system.

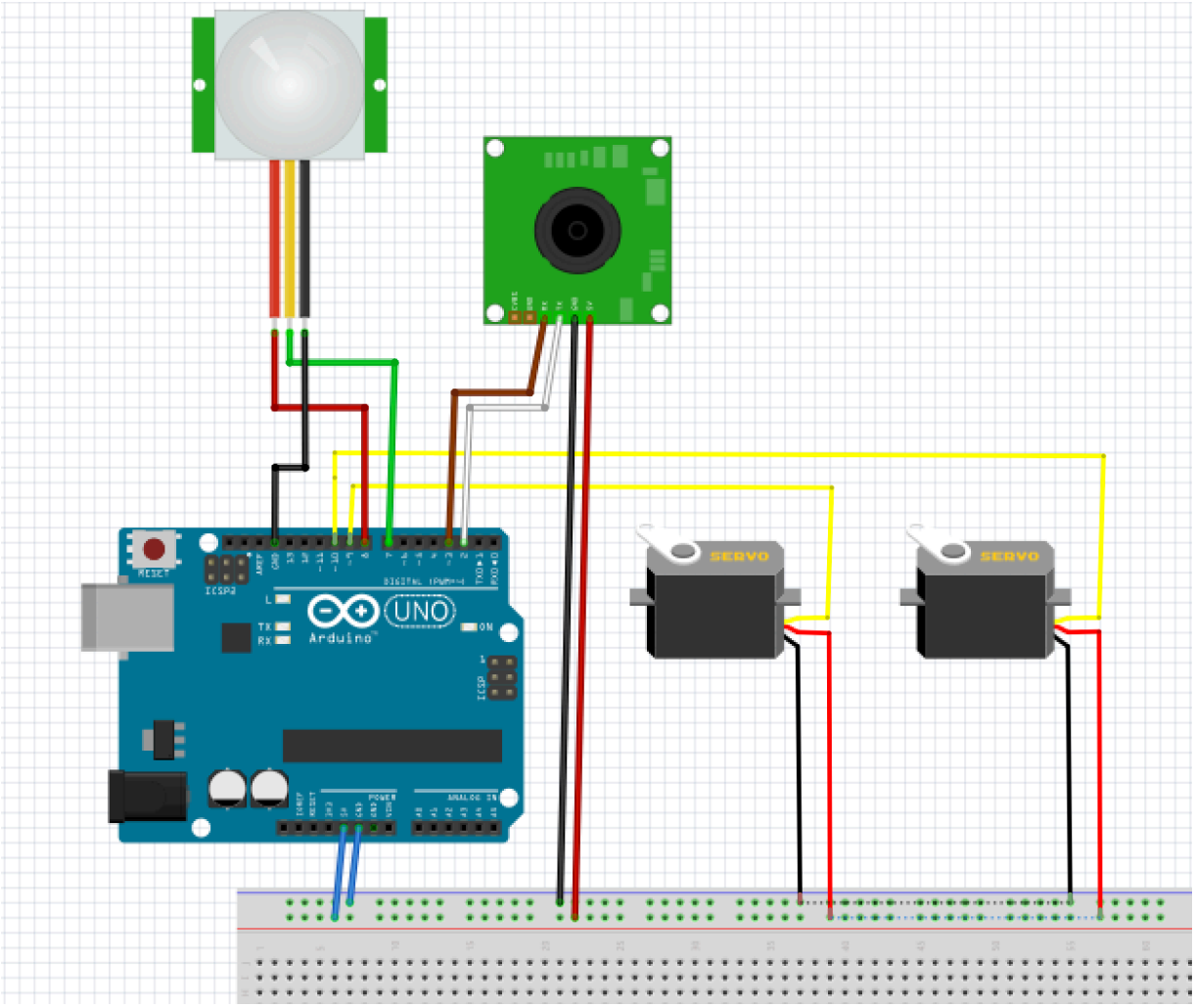
8) Reflection

Our smart home security system has taught us not only hand on experience but how to deal with unexpected problems that arise. Due to the time constraint and financial budget many of our ideas became too unattainable. Setting up the hardware part of our system was a learning experience such as assembling the router server and playing with the camera plus the motion sensor. As for the software part of our system a great knowledge was required to implement. While the basis of java and C++ and C was already known to us more advanced theories was required for us to learn to invoke different variables and classes through command line for our system. Some of the language platforms we had to use in our system were for instance Python and processing. Each of them has its own syntax and semantics that we had to learn from scratch. The OS touch application is a platform that can be quickly adapted to and has helped us develop an application to help us control the system. The more complicated issues that we faced were sending data from the server to the mobile app such as an email.

9) Summary of changes

Our initial plan was to create a system but due to the time some changes were made before the concluding our final project idea. The original plan was to create a live streaming video camera; due to our limited coding skills and time we were incapable of doing this. Instead the team changed the system to taking pictures in place of video. In addition to this a mobile app was required to be built to monitor the system. This became difficult to construct ourselves since we have no knowledge of creating an app.

10) User manual

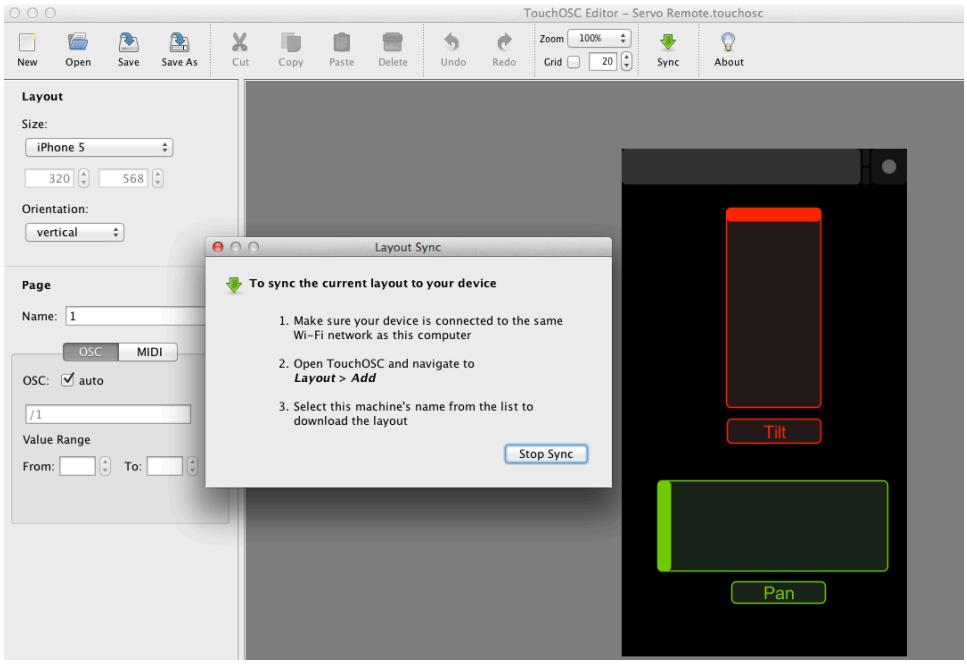


a) Connect all components with the right pin inputs as seen in schematic above.

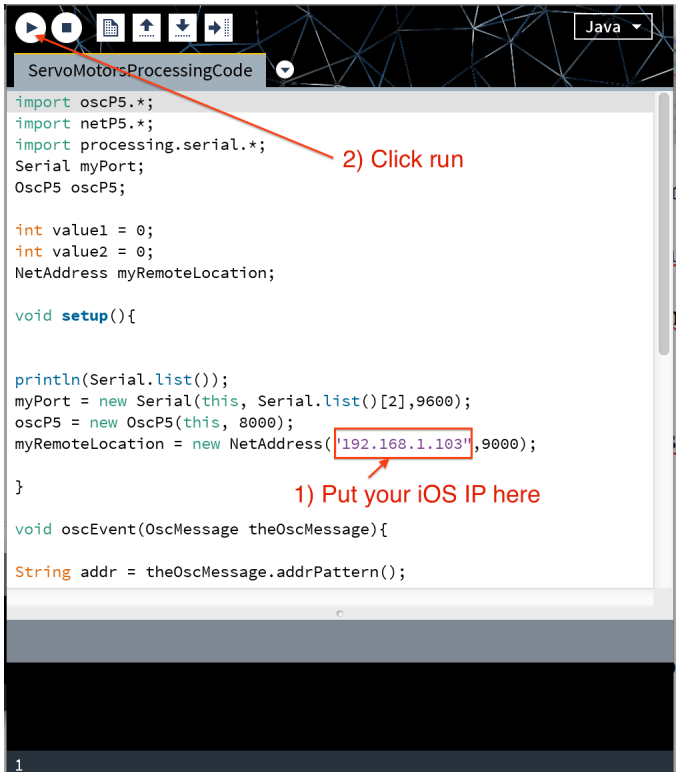
b) Open **Arduino IDE** and upload the sketch named “Arduino_Combined”

c) Open **Touch OSC Editor** software on MAC and load the file called “iPhone_Template”

d) On the top right, click on sync

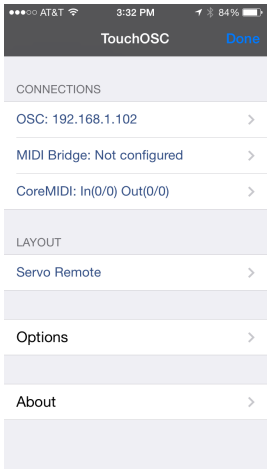


e) Open **Processing** for MAC and load the file called "Servo_Motors_eMail_Alert" , replace line 11, with your iOS IP address then click run.

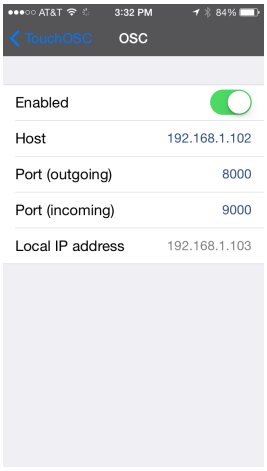


g) Now, on your iOS device, download **Touch OSC app** from the app Store ($4)

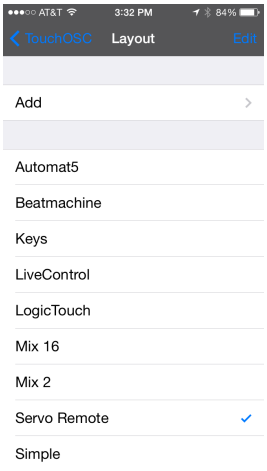
h) Open the app and follow these steps:



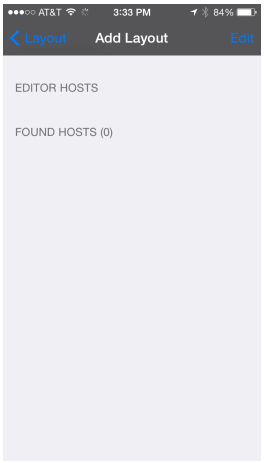
1) Click on OSC under connections.



2) Change Host IP to your MAC IP address. Then click on TouchOSC on top left.

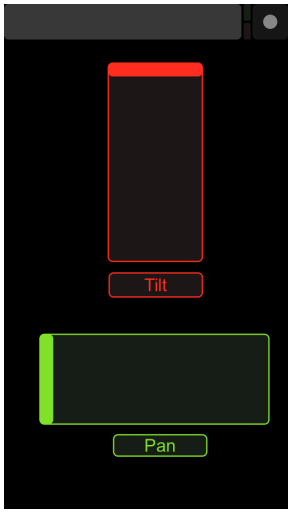


3) On main menue click on LAYOUT. Then click add on the new page.



4) iOS device will start searching for the computer in the same network that is using TouchOSC Editor.

Select your computer and click done



5) Now you are ready to control the angle of the camera by tilting or panning the servos

Note:

Though these steps are only required once. In the future, you only need to open the app and start using it right away.

i) Now open the python file called email.py and fill out your email address and password. Note that this step is secure since it is encrypted and uses your email provider security settings.

j) You are now set and your security system is ready to use!

Once you leave the house, and motion is detected, and email alert will be sent to your email and a photo will be taken and saved in the memory card of the Ethernet Shield.

11) Maintenance manual

Thank you for purchasing our smart security system! Our system can help you maintain the safety of your home from all unpredictable events. It is the upmost importance to keep the system up to date for your safety and the safety of your property, to relieve any stress. The following steps should be carried on a monthly basis so the system works efficiently and effectively.

1. Replace the motion sensor
2. Replace batteries for the server
3. Update computer software
4. In the case of a power failure, reset the whole system

12) Original Design Proposal:

Design Proposal

WVU Lane Department of Computer Science and Electrical Engineering
Mentor: Dr. Roy S. Nutter
Instructor: Dr. Yenumula V. Reddy
Authored By:

- Mehad Said
- Abdelkader Messaoudi
- Yonatan Tekle
- Kibrom Weldemariam

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The report was assigned as follows:

- Introduction, extended design problem, requirement design specification and final report arrangement and formatting - Abdelkader Messaoudi
- Project management plan - Mehad Said
- Requirment design specification - All group members

1.Extended Problem Statement

1.1 Abstract

Security systems have been a common necessity for homeowners who wish to protect their homes as well as their families. These systems can range from very complex to very simple depending on what the homeowner feels is necessary to spend. Without a security installed in the home, residences are left vulnerable to criminal break-ins that result in theft and sometimes an attack. The goal of this project is to create a cheap, self-installable, user friendly and reliable security system. We are going to do so, by implementing a motion sensor, a video camera that are fitted in a rotating motor which is controlled via a mobile phone app (Android/iOS) to give the consumer the ability to survey the residence and from that take the appropriate actions.

1.2 Executive Summary

There are many home security systems on the market which can improve the living conditions of the customer. One of the main issues that people face, is that these systems can be expensive, unreliable and non user friendly. Creating a system which is user friendly, effective and low cost will help people with low income to improve their living standards and afford the same security as high income homes.

1.3 Needs

Our system should be efficient in detecting intrusion and informing the user in real time. In addition to this, the system should be simple enough to understand and manipulate. One of the reasons of creating such system is making homes more secure for an affordable price.

1.4 Objective

The goal of our project is to design an affordable state of the art home security system for a larger audience. In order to accomplish this goal, several stages will take place in designing and implementing this. First of all, designing the main hardware of the system, then designing the central node system which collects data from the hardware component and finally, the software part that interacts the system to the user and vise versa.

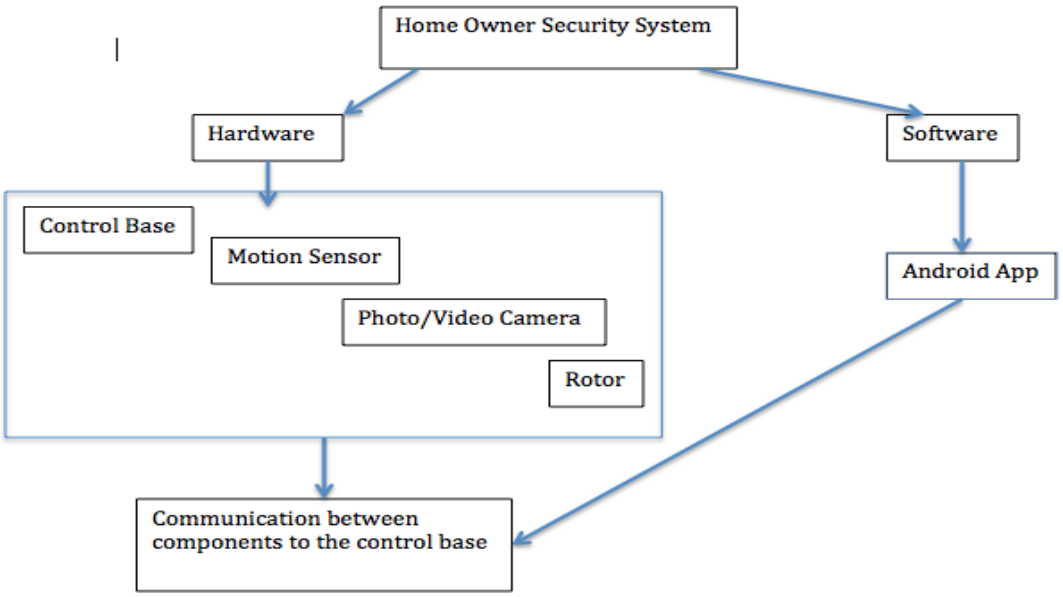
1.5 Background

The first alarm system was created in 1853 by Augustus R., which was an electro-magnetic alarm. Only rich homeowners in New York City used this. Back then; the design was groundbreaking compared to nowadays. By time, home security systems have become more sophisticated and advanced by implementing several technologies like cameras, sensors and wireless technologies, hence causing them to become more expensive. All of these cause problems for people who cannot afford the systems in their residence.

1.6 Stakeholder

Stakeholders is comprised of security corporations and homeowners. Our project cannot compete with big corporations but due to our low cost system, there could be a high demand market for this product from the low-income homeowners.

1.7 Objective Tree



1.8 Ranking Requirements:

1) Security system should be reliable and easy to use for the consumer.
2) Customer should be able to activate/deactivate the system at any time at any location*.
3) Assure that the system is secure from being disarmed by non homeowners

2. Requirements Specification

2.1 Function List

The following is the list of functions used in the ~~S&S Home Security System~~ Smart Home Security:

2.1.1 Telos B Functions

READ_DATA_MOTION_SENSOR

READ_DATA_TEMPERTURE_SENSOR

TRANSMIT_DATA_TO_SERVER(ARDUINO)

2.1.2 Central Node Functions (ARDUINO)

READ_TELOS_B_DATA_TRANSMISSION

CALCULATE_SECURITY_STATUS

TRANSMIT_DATA_TO_ONLINE_SERVER

CHECK_REPOSITORY_FOR_COMMANDS

RESET_SYSTEM

REBOOT_SYSTEM

2.1.3 Online Repository Functions

READ_DATA_FROM_ARDUINO.

SEND_DATA_TO_ARDUINO.

STORE_COMMANDS_FOR_ARDUINO_USE

ERASE_ALL_DATA

2.1.4 Mobile Device Application Functions

RETRIEVE_DATA_FROM_ONLINE_REPOSITORY

TRANSMIT_COMMANDS_TO_ONLINE_REPOSITORY

CALL_EMERGENCY

ACTIVATE_DEACTIVATE_CAMERA

CONTROL_MOTION

2.1.5 Camera Functions

READ_DATA_FROM_ARDUINO.

TRANSMIT_VIDEO_TO_ARDUINO

2.1.6 Camera Rotor Functions

READ_DATA_FROM_ARDUINO

2.1 Marketing Requirements

1. The system must be secured
2. System interface must be user friendly for user.
3. System setup and installation should be straightforward.
4. The system should be able to notify all homeowners if a situation is detected.
5. All the components within the system must be connected in an efficient way.

2.2 Engineering Requirements

- The communication node is Arduino Uno which runs on Ard OS.
- The system will be connected using wireless connectivity.
- The system must recognize the command from the user whether it's controlling the camera rotation or sending the alert to the appropriate party.
- The system should be up to date and secure so that no dysfunctions occur.

2.2.1 Mapping of Marketing Requirements to Engineering Requirements

Marketing Requirement	Engineering Requirement
Home Safety	Motion sensor, Camera
Real Time Feedback	Wireless connectivity
Smartphone Application	Networking
System Implementation	Arduino Uno, Ard OS

According to the table above, each marketing requirements corresponds to and Engineering requirement and vise-versa. The first marketing requirement is home security safety. In order to have this scenario, we have to implement the motion sensor within an area of the house. In case of an intrusion, this will trigger the lights and the camera. The system will be connected to Telos B which is a low cost reliable system. In order for this to happen, the system will be connected to Arduino Uno using radio transmission. To get real life feedback, the system will be connected wirelessly. One of the main advantages of this system is the user friendly control system.

2.2.2 Engineering and Marketing Requirements trade-off chart

The main concept we need to consider in order to achieve our project's goal are the hardware and software components. The Arduino is a simple straight forward system. Even though Raspberry Pi provides the necessary features to achieve the our goal, the reason we will be using Arduino is that it has a programmable microcontroller that has its own internal memory, it's operating system is customizable and is suited for hardware projects and is almost half the price of the Raspberry Pi.

2.2.3 Competitive benchmarks

Name	Self-Install	Mobile App	Price
WVU	Yes	Yes	$150 One time fee
Xfinity Home	No	Yes	$39.95/ Month
Front Point Security	Yes	Yes	$279.99 One time fee + Optional $42.99/month service
Safemart	Yes	Yes	$19.95

2.4 Constraints

The constraints of our project depends upon the implementation of the hardware and software components at a low cost. In the market, there are many different systems available with almost similar features but with higher rate compared to our product which has no monthly fee, is user friendly and easy to install.

2.4.1 Economic Constraints

The goal is to make this system as low cost as possible. Only the purchase price will be considered without any impact on the consumers housing bill.

2.4.2 Legal Constraints

The main purpose of this system project is for security reasons and any other use of this system will satisfy the system's role.

~~2.4.3 Environmental Constraints~~

~~Telos B will run on batteries and this causes an environmental hazard. We can reduce this effect by using rechargeable batteries.~~

2.4.4 FCC Guidelines

Our system consists mainly of communication between the components and also the user. All communication requirements can be found from the FCC website below.

www.fcc.gov

2.4.5 Health and Safety Constraints

Our system will not have any side effects on the user's health. And since the main priority is security, the system is designed to deal with that. Our product is a self-installable and further instruction will be provided in the manual. As with any security system, outlet plugs will be part of the system, hence, the user should take extreme caution.

2.4.6 Political Constraints

IEEE standards will be used.

2.4.7 Manufacturer Constraints

Telos B is main component in our system. The central node which consists of Arduino Uno which is an open source platform.

2.4.8 Social constraint

The interface that will be used between the hardware and software should be easy to navigate. All data received and transmitted should be clearly displayed in the users mobile app.

2.5 Standards

2.5.1 Safety

The system should be under laboratory testing

2.5.2 Data Formats

All data transmitted and received will be stored on the Arduino memory

2.5.3 Programming Languages

The OS that will be used on the Telos B is Tiny OS, and Ard OS for Arduino. As for our mobile app, we will be using Java programming.

3. System Design

3.1 Scope

In this project, we took the wireless network technology to its next level by implementing it with security system that can interact with the home owners by a means of mobile application. The design of this system is as follow. ~~The TelosB Mote is a power-packed wireless transmission device. Each node sensors (different peripheral devices) are connected to the central TelosB sensors. The central TelosB collects all the data and transmit to the on board computer~~. The Arduino UNO is a very small computer used as bridge to connect the central node and the online repository. At the same time it stores the most recent security data fetched by the sensors. From the online repository, the application designed for mobile devices takes the data and delivers the ongoing activity via text message. At the same time, the user can send a command such as rebooting, arming and disarming the systems.

~~3.2 TelosB~~

~~It is also called smart-dust. It now has a very high demand in wireless communication. This device is low-power computer as its base, which in turn is connected to other sensors and a radio transmitter that then forms network. TelosB comes equipped with integrated onboard antenna, to allow communication between the sensor and the central node. its has six pins which allows us to connect all the sensors all at one time. Moreover the sensors can be powered by the battery or can hooked up to the computer. These sensors detects like sound, light, stress, vibration, pressure and humidity, position and acceleration and others (in our case motion and light sensor). This device is connected to each node by a means of radio transmission and to the central nodes. The TelosB is an open source platform. we can use an USB connector in order to program the device.~~

3.3 Moveable Nodes

The moveable nodes are parts on the system that are integrated to the central TelosB via wireless connection. These moveable nodes receive and transmit data to and from the central node when different events occur. The main purpose of the moveable node is to detects a movement in any parts of the household and sends a message to the central node.

3.4 Central Node

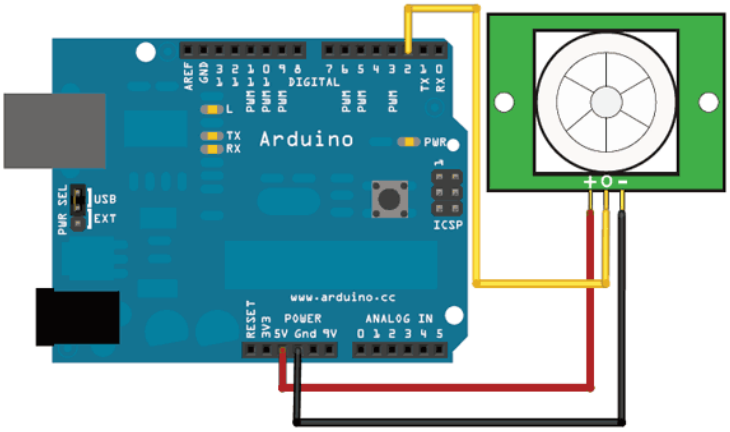
The central node is a combination of the TelosB and Arduino UNO via USB port. The main function of the central node is to receive transmitted data from moveable node and process that data and sends back data to take appropriate action.

3.5 Mobile Device Integration

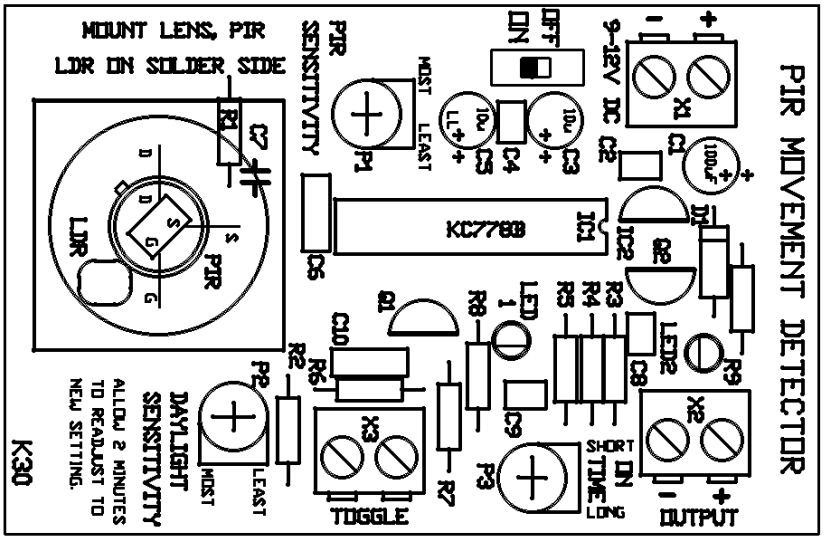
Once the information gathered at the central node, the data is then transferred to the mobile app device. At this time the user should be able to take appropriate actions. And also the user can arm and disarm the whole system.

3.6 Circuit Diagram and Schematics

3.6.1 Motion Detector:

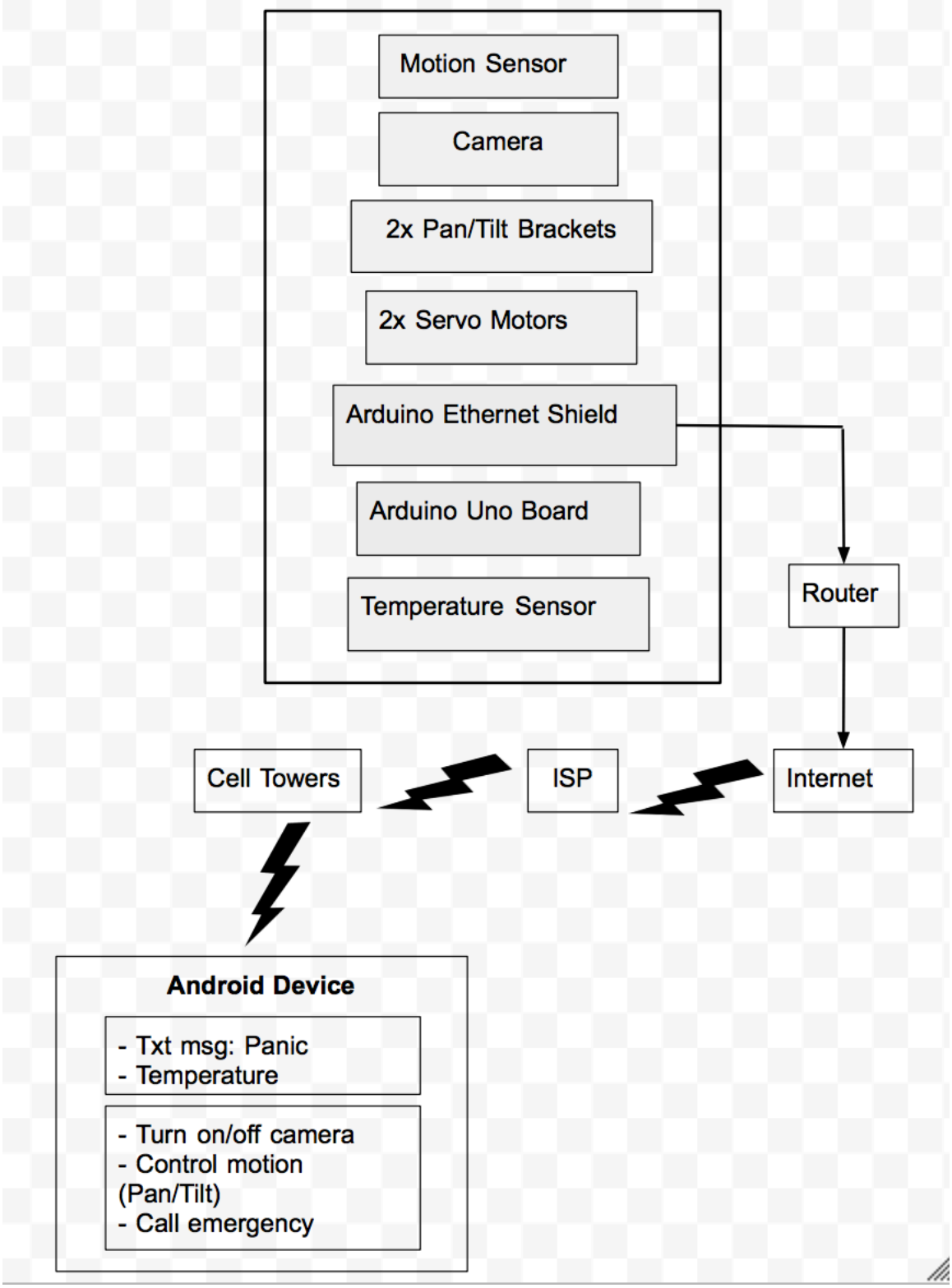


Basic Motion Detector Diagram



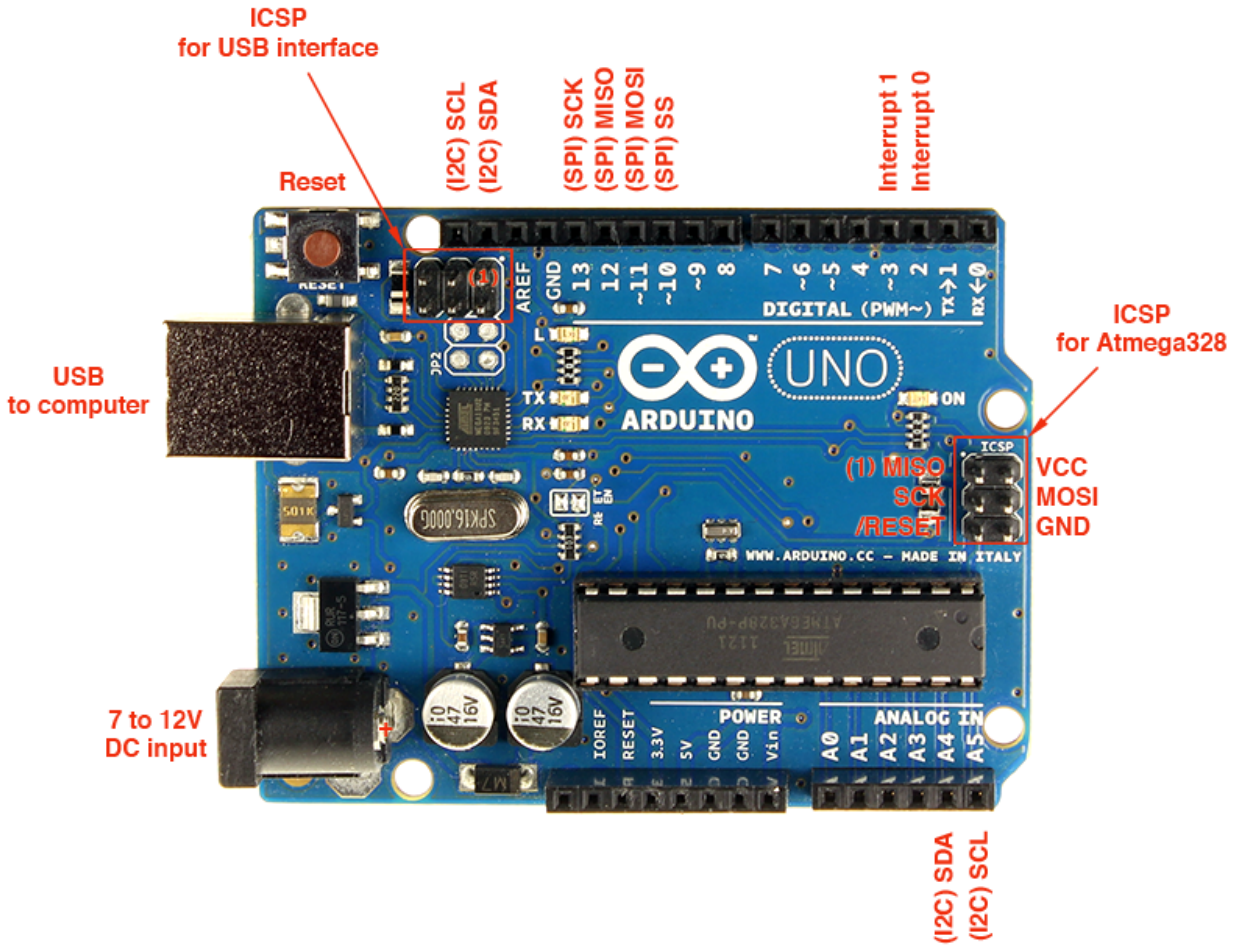
Motion Sensor Diagram

3.7 Context Diagram (New Diagram)



3.3 Arduino UNO

The Arduino Uno is a microcontroller board. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, aUSB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. In order to connect it to the internet, Arduino Uno uses an ethernet shield.



Arduino Uno board

3.4 Mobile Application:

The data transferred from the sensors goes to ~~the telosB remote, hence goes to~~ the Arduino, and then goes to the user's Android mobile app to display the security information. Once the user gains access to this information, he can take necessary steps to resolve this situation, such as panning the camera angle, calling the security or resetting the system.

4. Testing

4.1. Component tests

Our first part of the components that needs to be tested is composed of a camera, a motion sensor, a rotor and the light. The second part that needs to be tested is the ~~TelosB remote~~, Arduino Uno , and the internet shield. The last components that we will be testing will be the phone application.

The communication starts from the motion sensor to the central node. The central node picks up the data that is transmitted from the first node (motion sensor) and sends a notification text to the user mobile app. At the same time, the central node will give a command to the first node to take action (in this case take photo) and sends it to the user.

The communication between the central node and the mobile app takes place through the internet network.

The data communication from both ends are very important and should be tested to ensure that the system works properly.

Mobile app:

- Testing the ability to send and receive data between user and central node.
- *Test if the received information is accurate.*
- *Test if the user can reboot the entire system remotely.*

~~Telos B remote:~~

~~- Test the connection between the motion sensor, the camera and other peripheral devices (rotor, light).~~

~~- The telos B should be tested to see if there is a connection between it and the central node.~~

Camera:

- Test the ability to take picture and videos and switching between both modes via Mobile app.

Motors:

- Test if the rotor rotates in every direction specified by the user through the mobile app.

Sensors: (New)
- Test if the motion sensor detects objects and test the temperature sensor as well.

Central node:
- Test its ability of receiving and sending information from both ends (user/motion sensor)

4.2. Failure mode analysis

Failure Mode	Cause	Effect	Solution
Internet Network	No data transmitted	No instant communication	- Contact network company
~~Battery~~	~~No data transmitted~~	~~Failure of system~~	~~- Replace battery - Notify the user via app low battery~~
Arduino Uno	No electric power	Fail of entire system	- Make central node to work on battery power and electric power
Communication between nodes	interference between nodes	Fail of the system	- Notify and Replace

4.3. Integration tests

Sensors to Central Node:
This test will show if the data received/received from the sensors to the central node is working efficiently.

Central Node to Mobile App

This is the main part of the system and testing it will show that the information received/transmitted from the sensors to the central node can move forward to the mobile app. We will also test the ability of the user to interact with the system.

5. Project Management Plan:

~~Activity~~	~~Hours Spent~~	~~Weeks of Activity~~
~~Construction of main control base~~	~~-~~	~~-~~
~~Design of wireless sensors (Motion sensor and camera integration, rotor)~~	~~-~~	~~-~~
~~Development of operating system~~	~~-~~	~~-~~
~~Creation of app which integrates all devices together.~~	~~-~~	~~-~~

Smart Home Security

1. Plan Project

1.1 Develop Work Plan

1.1.1 Develop Work Breakdown Structure

1.1.2 Develop Project Schedule

1.2 Finalize project plan and Gain Approval

1.2.1 Order Project Parts

2. Execute Project

2.1 hardware

2.1.1 Assemble Components

2.2 Software / Coding

2.1.1 Motion sensor/Temp sensor <-> Arduino

2.1.2 Camera motor <-> Arduino

2.1.3 Camera video <-> Arduino

2.1.4 Android App <-> Arduino

3. Close Project

3.1 Final Testing

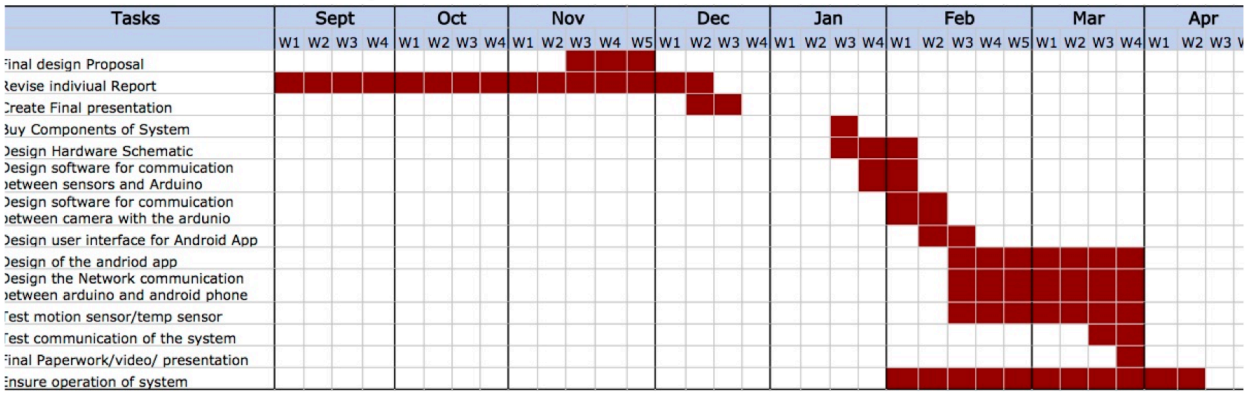
3.2 Present Project

3.3 Celebrate

5.1 Work Breakdown Schedule

~~ID~~	~~Activity~~	~~Description~~	~~Members~~	~~Sources~~
~~1~~	~~Device~~	~~Construction of the product.~~	~~4~~	~~Motion sensor, camera, rotor, and microprocessor.~~
~~2~~	~~Server (Control Base)~~	~~Designing the Telos-B wireless/turning the PC into server.~~	~~4~~	~~Telos-B , PC~~
~~3~~	~~Networking~~	~~Communication between all components.~~	~~4~~	~~Sensors, transmitter/receivers device.~~
~~4~~	~~Coding~~	~~Coding which allows system to run smoothly.~~	~~4~~	~~Java, XML, MySQL, C++~~
~~5~~	~~Interface between hardware/software.~~	~~Ensuring the signals received/transmitted from the device to the base can be manipulated via App~~	~~4~~	~~Everything combined.~~

1. Task assignments and associated deadlines


Tasks
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W5 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W5 W1 W2 W3 W4 W1 W2 W3
Final design Proposal
Revise indiviual Report
Create Final presentation
Buy Components of System
Design Hardware Schematic
Design software for commuication between sensors and Arduino
Design software for commuication between camera with the ardunio
Design user interface for Android App
Design of the andriod app
Design the Network communication between arduino and android phone
Test motion sensor/temp sensor
Test communication of the system
Final Paperwork/video/ presentation
Ensure operation of system

5.2 Personnel Assignments (New)

1) Hardware (Abdelkader+ Mehad)

a. - Assembling the motion sensor to the Arduino Uno

b. - Assembling the temperature sensor to the Arduino Uno

c. - Assembling the Camera to the Arduino Uno

d. - Assembling the Camera with the router to the Arduino Uno

2) Software

e. - Code for motion sensor (Mehad)

f. - Code for Temperature sensor (Mehad)

g. - Code for camera (Abdelkader)

h. - Code for rotor (Abdelkader)

i. - Android app (Mehad + Abdelkader)

5.3 Milestones:

1	Communication between sensor and ~~control base~~ and Arduino Uno
2	Receiving data from and to the ~~central node~~ Arduino Uno
3	Getting system to "turn on when detection is detected.
4	Ability to turn on/off system from app smart-phone

6. Appendices

6.1 Procurement Plan:

Item;	**Quantity:**	**Prices**
Motion Sensor	**1**	**$10**
Temperature Sensor	**1**	**$3.5**
Motors + Brackets	**1**	**$22**
Camera	**1**	**~~$18~~ $39.95**
Arduino Uno + Ethernet Shield	**1**	**~~$25~~ $59.95**
Smart-phone	**1**	**Already Available**
~~Telos B wireless remote~~	**~~2~~**	**~~$35~~**

6.2 Contingency Plan:
As of the moment, we are still investigating a contingency plan.

6.3 Wiki Website
The website for the group project is the following:
https://seniordesign.lcsee.wvu.edu/2013fallee480-gp01/

The website will cover all project details including: Meeting dates and overviews, project documentations.

6.4 Individual Reports

Below are the individual reports of the group members

Smart security system

System Manual

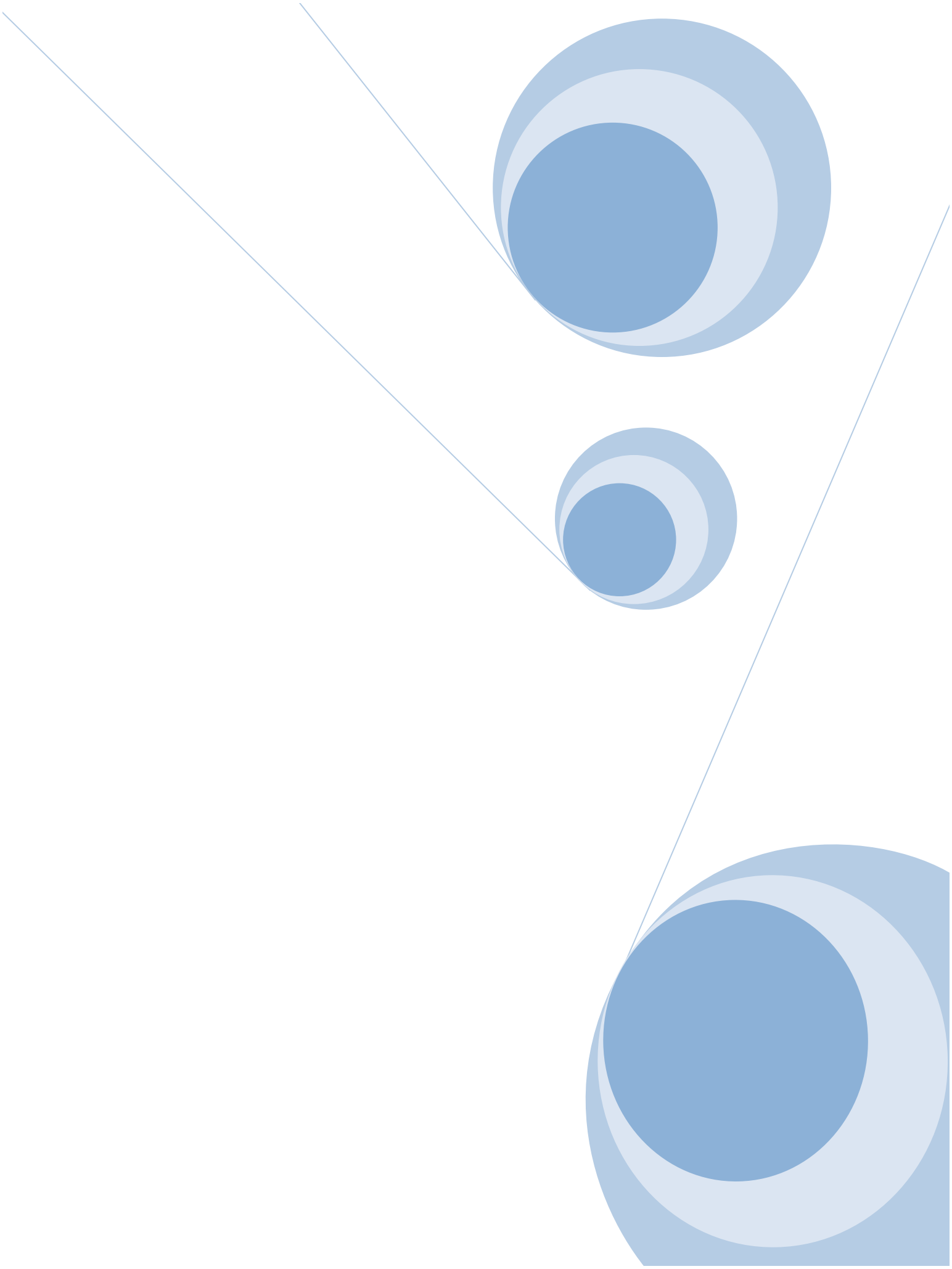


Table of content:

- **Abstract.**
- **Ranking of needs**.
- **Background.**
- **Objective.**
- **Objective Tree.**
- **Stakeholders.**
- **Reference.**

Introduction to Home Security Systems:

Home security is a computerized system that denies unauthorized access to facilities for unwanted visitors. This is done by creating layers that will make it increasingly difficult for criminals to break in and steal things or harm you or your family. This layer is user defined and is usually by modern technology equipments such as cameras, sensors, and etc. There are two types of home security systems that exist in the market today monitored and unmonitored systems. Monitored Home Security Systems are trustworthy, powerful systems that mesh out of the artwork security technological innovation with trusted checking services.

The systems that will protect your home form intruders all year long 24 hours 7 days a week. They will operate under the management of the company's central main monitoring office so if a hazardous event likely happens for instance burglary tries to step into house through the window/door a built in siren will be trigged hence alerting the office hence professional authorities will be notified to deal with the predicament. As in the case of fake alarm the office will still inaugurate to notify authorities to go and check out the neighborhood.

Even though this system sounds/looks outstanding it has its fall backs. The alarms are skillfully wired into your home resulting in a large consider "self-monitored" alarm system that just even before signing that expensive office monitoring charges contract. In addition to these charges the fact that your property is been viewed; monthly expenses are paid any potential untrue alarms can result considerable increase value fee of the system.

On the other hand unmonitored home security systems lack overseeing but utilize comparable house alarms that will scare the compelled entry of a burglar. These systems will simply create a loud audio since alerting the owner, neighbors, and any person who lives nearby the house. Like the monitored system several sensors motion, cameras are disposed all over the house and when an event likely happens a loud siren is triggered. This noise alerts the owner and neighbors' that something is not right hence solving the situation. These systems don't require for the person to spend monthly fees on monitoring or screening like monitored systems. However the downside is that if the situation is big the owner has to make a call to the enforcement and wait for them to get at the scene.

Objective:

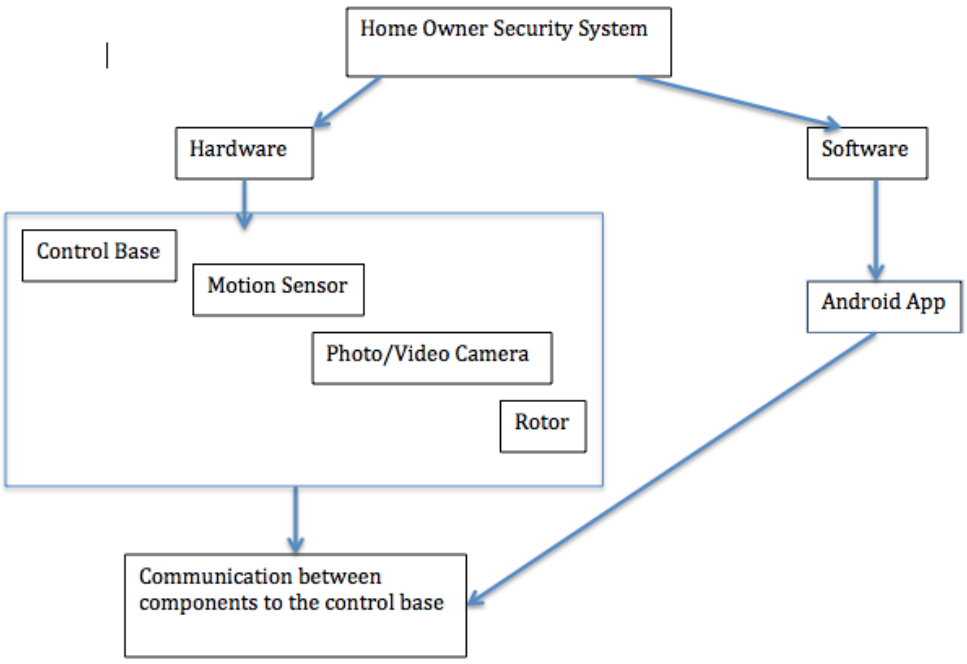
Our Smart Home Security system should meet key aspects to make it a state of art technology.

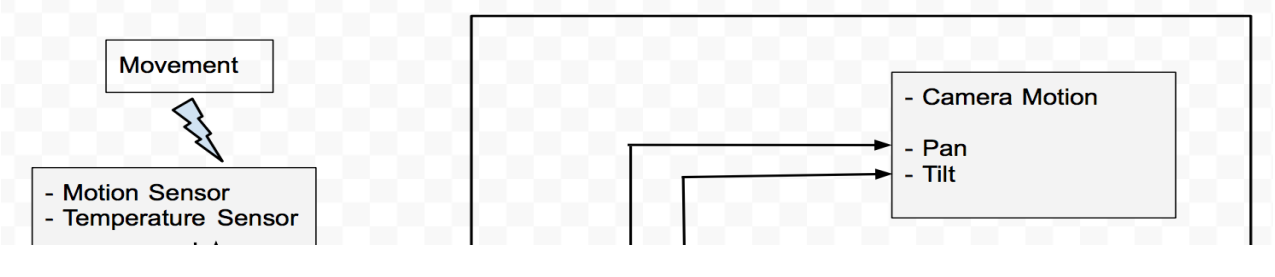
- Flexible user interface.
- Safe.
- Accurate
- Low cost
- High speed transmission of data
- Mobile Syncretism
- Sensors
    1. Motion
    2. Temperature.
- Easy integration with sensors.
- Time functional.

Stakeholders:

S&S intends to a large group of people. We expect our systems to take over the market in time because it make the user feel relaxed and happy knowing that their homes are equipped with safe, accurate, reliable security system. In addition our system has no subscription fees only one time deal with life time guaranteed warranty. Our number one ideal customers are low income individuals, families that have children to come home while they are at work; and even college students who are unable to afford high tech security systems. Customers range from single to married to families who own/ have access to smart-phones to access their security systems. Our system has various package deals depends on the users ends.

Objective Tree:


Home Owner Security System
Hardware
Software
Control Base
Motion Sensor
Photo/Video Camera
Rotor
Android App
Communication between components to the control base


Movement
- Motion Sensor
- Temperature Sensor
- Camera Motion
- Pan
- Tilt

Previous Solutions/Scenarios to Home Security Systems:

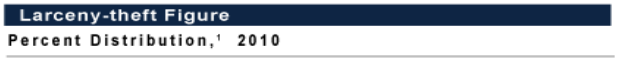
Security is the most important factor is any situation it keeps our mind and body at peace during crisis. Technology has provided many useful services to mankind especially home security systems. Early security systems included “Baolis” in India, strong safety boxes with padlocks in Rome to massive fortifications in Europe. A lot of the early systems were derived for the protection purposes, in modern times these still coexist with new versions of home systems try to accomplish. The world has come a long way so has technology.

Nowadays monitoring systems have wide variety of devices from carbon monoxide sensors to 3D-180 cameras to create a sense of safety to our premise. Companies such as Front-point provide the user a monthly fee of $50 all services included. Other companies such as ADT even though it provides the user with a state of art technology you will find that GE and Honeywell logos copyright on the keypads and sensors. It seems that the world is in the path of systems that are reliable and extensible.

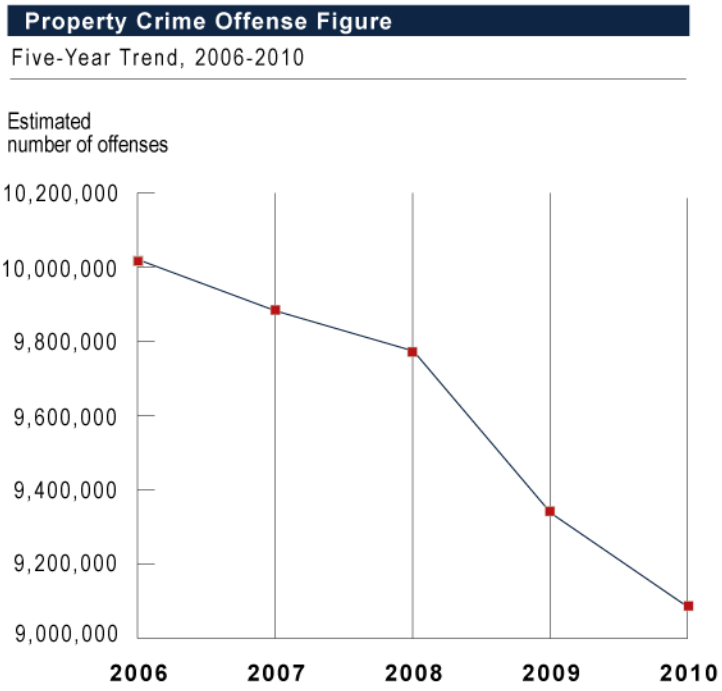
Security Systems	Advantages	Disadvantages
Front point Security	Offers variety of videos and information for user.	Warranty of equipment's limited
Protect America	Basic security system easy to use.	Installation is done by one-self.
Safe-Mart	Offers the users a variety of security equipment's. Low cost system.	Installation is done by one-self.
Pinnacle Security	Provides user with mobile interactive system. Company has years of experience with costumers.	System is only available near retailers.
ADT	Provide high class security systems.	High monthly fees
Protection 1	No landline required for service	Provide very little learning about security systems.
Life-Shield Security	Free basic security system	Self-installed system
Monitronics	Reuses existing system hence saves you money.	Doesn't provide dealers contract.
Alarm- Zoned	Average rate monthly charges	Least amount of FAQ, online information
Alarm-Force	Large variety of security systems.	Doesn't provide interactive

Purpose of a home security Systems:

Many people overlook home security with the attitude that danger will never happen to them. In 2010 according to the (FBI crime report) almost an estimate of 6 million larceny thefts have occurred worldwide with this estimation to be exact 2,000 larceny theft per



10,000 residents. The average stolen property item per larceny theft ranges from 800-1000 dollars per offense. The following charts show crime trends from 2006-2010



S&S System

Electronic technologies especially security systems have provided humanity with many services due to evolving technology. In today's market majority of home security systems don't have self-installation systems; they require/ have expensive subscription fees up to $300 and in top of that monthly fee. Our team's first goal is to eliminate these tedious high costs attached with these security systems. Our system intends to do this by creating a self-installable system with no subscription or monthly fees; hence allowing the user to easily set up the system at his/her convince.

In order for the user to gain access to this state of art technology system the customer selects the package that meets his/her home needs. This systems includes wireless motion sensors, a camera, and a rotor all integrated together in top of that the central base unit with the software manual. In order for this system to work effectively

and efficiently the end user chooses which locations requires monitoring. If a certain intruder is detected the motion sensor gather information sends it to the central node. From the central node the end user receives a text message through the Ethernet connection at the same time the camera and rotor are turned on and the end user receives a video clip of the situation. In order for the end user to get information he/she has to download the software to mesh with the system.

The user once he/she downloads the software has the ability send commands to update, disable the systems, take appropriate actions at his convince. The following list is can be controlled by the end user.

Settings	*System Description*
Account information	Modify app information sync to.
Contact information	Who, when to contact when motion is detected.
Alarm/Disarm	To change states of the system
System Testing	Test to check if needs updating and working efficiently and effectively.

Implemented Technology:

In our S&S home security system we will be make use of two major devices the Telos B mote and the Auduino Uno. The Telos B is useful due to high compression eight sensor channels. Telos B sensors are highly compatible over multiple platforms due to easy deployment through USB port. They are placed within the premises and due to its high advanced data broadcast meshed with onboard antenna integrated on it; it can collect data and sent it to the central base using radio wave frequencies. The sensors will determine what kind of data will be collected.

Sensors

Motion Detector	Activates when motion detected
Temperature Detector	Activates when temperature changes.

The central Base is Auduino Uno which is a microcontroller board powered by a USB connection or an external power supply usually an AC/DC adapter or battery. The Auduino software which runs the operating system includes a serial monitor which allows simple data to be transmitted/ received to and from the Auduino board. We currently haven't decided on the operating system of the Linux or Mac OSX. This central node has 14 digital pins used as input & output to receive and transmit data on/off board. Once this central node captures the essential data it sends it to the

end user through Enternet through Bluetooth & Infrared. The other side of this technology is the motion detector which we are going to build to minimize cost as for the camera it will be the only component we will purchase. As for the Android mobile app application this was chosen because it's much easier to code this than other platforms such as Apple & Samsung. Once the user set up software he/she can configure certain aspects of the system, to tailor it to his or her needs.

Origination within the System:

One thing that separates S&S system from others is the fact that is has all in one package the camera, motion sensor, rotor all in one device with a price of $150 that's quite eye catching. There is only one product similar to your product by Front-point Security but they sell it for $300. In addition our product doesn't include any addition fees in contracts to Front-point security.

Challenges:

We as a group will definitely face challenges along the way. First the building the PIR sensor will prove to be the most challenging part of the hardware. The coding required for the Auduino Uno and the Mobile app will be new to all of us. Meshing the hardware and software and making sure transmission of data between modules will be interesting. Although all these aspects look hard but with the help of our mentor and help of each other this is an achievable project.

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SMART SECURITY SYSTEM

System Manual

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Instructor: Dr. Yenumula V. Reddy

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Problem Statement

Private home security and surveillance has had a rich and long history and plays an important part in everyone's life. The industry has grown to become an over one hundred billion industry since its inception in 1851, with many technology firms also entering the market. Private

security technology is changing the perceptions of security and surveillance as many engineers and programmers advancing their skills in both hardware and software (Lock 2004).

Currently, security and surveillance is given high priority by home and business owners who want to ensure that their loved ones as well as assets are protected. The focus of this research paper will be to describe, design and implement a reliable, user friendly and user installable wireless home security and surveillance device system. According to Gammon (2011) AT & T home security system cost per user is $350 for the installation excluding the monthly fee of between $30 and $50 depending on the security package installed. With this in mind, it is justifiable that a more affordable system that is efficient be designed for use by low-income households so that they too can enjoy the protection of their assets. The project seeks to describe the design and implementation of motion sensor security device with surveillance capabilities that will be controlled through a smart phone app, which can be used by a homeowner to survey his property from a remote location.

Abstract

Security systems are no longer a luxury as crime levels escalate and more burglary cases are reported on a regular basis. These systems are now becoming mandatory for homeowners who wish to safeguard their assets. The home security systems vary from the basic and simple to the more complex systems with added features and capabilities and homeowners have a choice depending on their budgets and security needs. Residences that are not secured using these

automated and smart systems are left vulnerable to burglaries that may result in theft and or attacks. The project's objective is to design and implement a security system that employs the use of video cameras and motion sensors fitted in a rotating motor that is remotely controlled using a mobile phone application that runs on the Android Operating system platform. This system will afford the consumer the ability to remotely survey and secure their residence and to take appropriate actions in the event of a breach.

Executive Summary

The home security and surveillance devices market has many device options that can improve the security in homes and ensure that homeowners enjoy their living conditions without the fear of a security breach. Some common problem facing homeowners that are looking to secure their premises is the relative costly nature of these devices and systems, the non-user friendly nature of some of the devices and the unreliability of others. Designing a system that will be cost effective, user friendly, effective and innovative will help in the improvement of living standards of most low and middle income households in the United States.

The Need for the System

From the problem background identified, the system that we design will be effective and efficient in the relaying of real time information to the user in the event that it detects an intrusion or other security breach. Additionally, the system will be designed in such a way that it simple enough to understand and operate i.e. an average user can arm and disarm the system. The most significant need that the system addressed is the provision of affordable and effective home security and surveillance system.

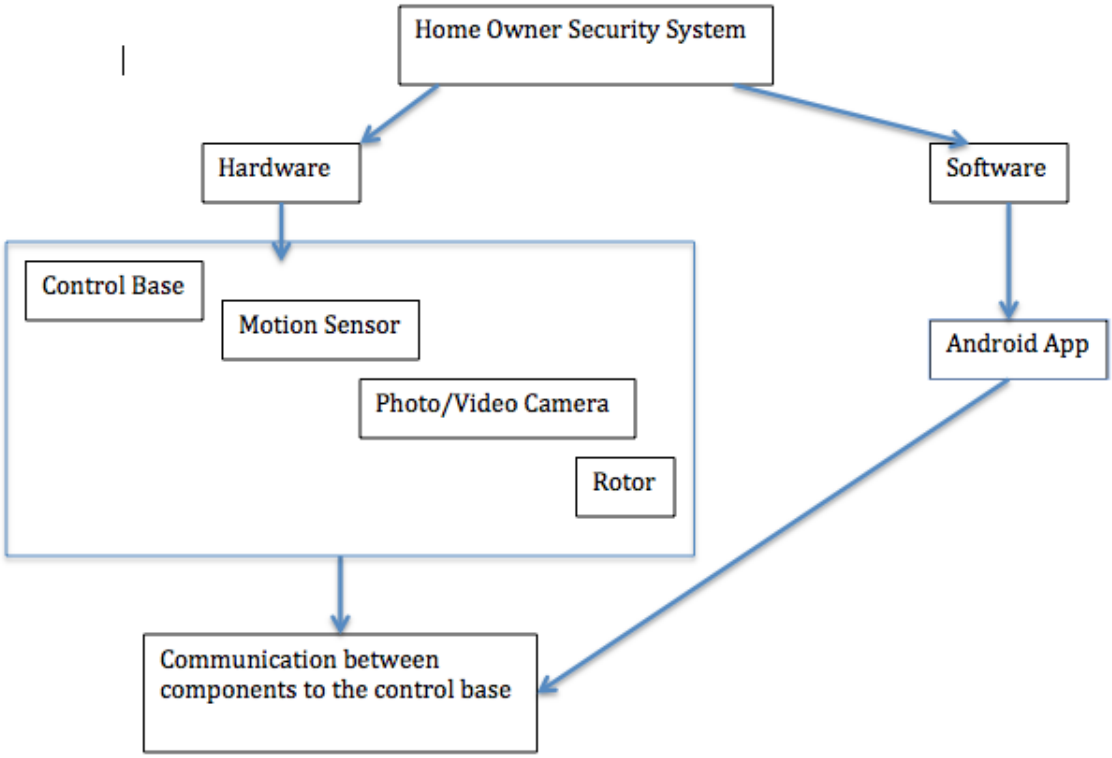
Relevant Stakeholders

The stakeholders in this sector include the private security firms, the homeowners as well as the law enforcement authorities that work in tandem with the security corporations. Since the system being designed is not meant to compete with the already established firms with advanced and costly devices, there is anticipated high demand as the niche we target is the low and middle income homeowners demographic.

Design Project's Objectives

The major objective of this design project is to create a state of the art home security and surveillance system that is affordable and that targets a mass market. In order for this goal to be realized, there are several stages that must be taken into consideration in the design and implementation process. Firstly, the structure of the hardware framework system must be drawn followed by the design of the central node system that communicates and collects data from the Hardware system and thereafter the programming of the software application that will act as the interface between the user and the system and vice versa. The objective tree below illustrates the process and the general outlook of how the components i.e. the hardware, the central node system and the mobile application software will link to create the security and surveillance system. In a nut shell, the system must exhibit reliability and ease of use by the consumers, the system must be secure non homeowners must not be able to disarm it, they should also be able to arm and disarm the system at any time and any location.

Objective Tree



Design Methodology

This section will give the step by step process flow implemented in the design and development the security system. The initial process involves researching the project background and literature review on the subject. The problem was formulated using the research study and subsequently the objective and scope of the study were designed. The next step involved the planning of how the project would be organized and the solution systematically arranged.

The project was divided into three parts, the hardware design, the interfacing and the programming and development of the related software app. The android Operating system was chosen for the software application and the Proteus 7.0 software was picked for the circuit design of the Arduino UNO while the central node system interface will be programmed using MPLAB. The completed circuit design will be implemented on the Arduino Uno, which will be the central

component of the design. The TelosB Mote is the wireless power-packed transmission device that will be used to relay information to the software app on the phone. Each of the central node sensors i.e. the peripherals will be connected centrally to the TelosB sensors. The TelosB system will be responsible for data collection and transmission to the computer. The bridging devices that will be used to interface the central nodes to the online repositories, is a very small computer referred to as the Arduino UNO. It will also simultaneously store the security data caches retrieved by the motion sensors. The software application designed for the mobile devices will take the data and relay the ongoing activity as it is captured via text message. The user can then automatically reboot, arm or disarm the system from the mobile application.

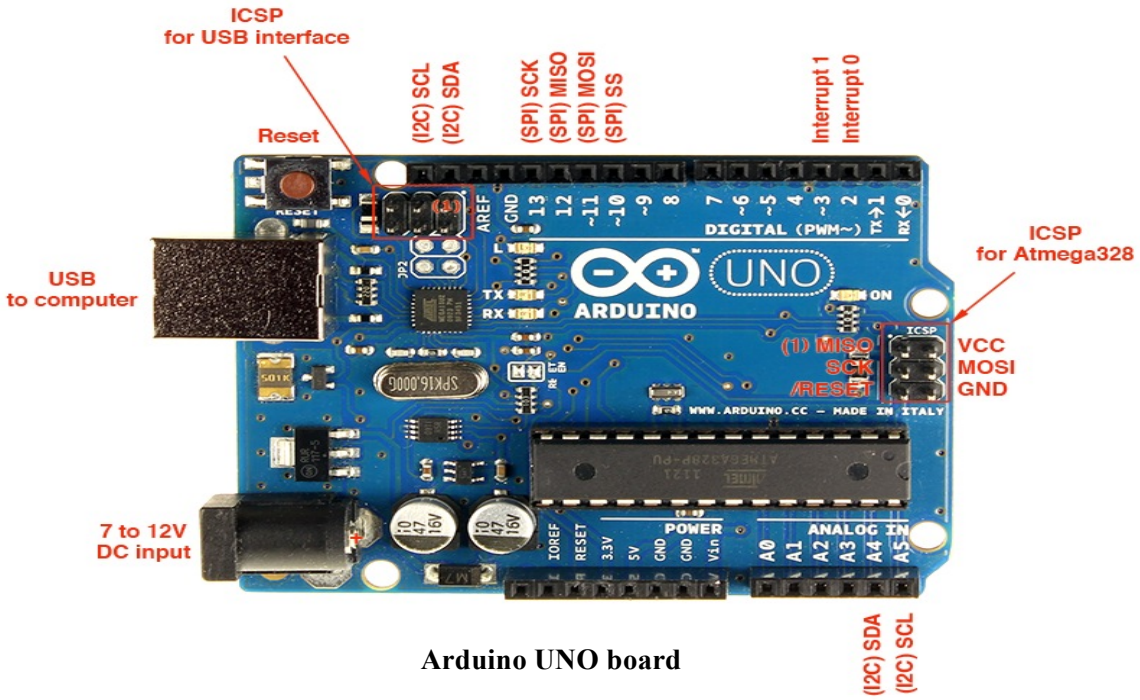
Hardware Development

The hardware section of the system consists of four important components, the TelosB Mote, the Arduino UNO, a camera and a base rotor.

Arduino UNO

This is a microcontroller circuit board that incorporates 14 digital input/output pins. Six of these circuits can be used as the PWM outputs, 6 can also serve as analog inputs. The Arduino UNO also consists of a 16 MHz crystal oscillator, a power jack, a USB connection, a reset button

and an ICSP header. All these components are necessary in the operation and support of the microcontroller. The process is as simple as connecting the microcontroller to a computer using a USB cable or powering it using a battery or an AC-DC adapter and the Arduino is ready to boot. This is a fairly new circuit technology as all other preceding boards incorporate an FTDI USB-to-serial driver chip. The Arduino is different in that it has the Atmega8U2 programmed to work as a USB-to-serial converter. An Ethernet shield is used in order to allow the Arduino to have internet connectivity capabilities. The diagram below is an illustration of an Arduino UNO board



Arduino UNO board

Software Development

Java programming language will be used to develop the Android application that will communicate with the microcontroller. The following is a flow chart of the software development phase-by-phase process.

Mobile Application:

Data is transferred from the sensors and relayed to the TelosB's remote sensor. From the TelosB, the data is then transferred to the Arduino and then moves to the Mobile application designed for the Android platform. The mobile application designed for the Android Operating system displays the security information or alternatively triggers a process that sends an SMS message to the users GSM network. Once the users are in possession of this information, they can then proceed to take action to resolve the breach attempt through altering the camera angles, alerting the security company or law enforcement or raising an alarm from the phone.

Testing

This is among the last stages in any design implementation project and involves a series of tests that ensure the system works in a flawless manner and that data relaying is efficiently passed through all components. The testing involves 4 key areas that determine the performance of the security system. These include;

Components Testing

The components that require testing include the motion sensors, the cameras, the motor and the lights. The second phase of components that will require to be tested in relation to the mobile application is the Arduino UNO, the Ethernet shield and the TelosB. The third stage will be the mobile application testing phase. The following are the tests that will be conducted to check for usability as well as integration capabilities. The mobile application will be tested for its ability to send and relay data to and from the central node, the information will also be checked for accuracy and lastly if the user can arm, disarm and reboot the system remotely. The TelosB will be tested for connectivity between the motion sensors and central nodes. The cameras will be tested for remote panning capabilities as well as the ability to switch between the picture and video camera modes and ability to relay data to the mobile application. The central node will be tested to check for ability to receive and send data from the motion sensors and the mobile application.

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